PATENT ABSTRACTS OF JAPAN

(11)Publication number : 10-219354
(43)Date of publication of application : 18.08.1998

(51)Int.CI. C21D 9/00
C21D 1/52
F23L 15/02

(21)Application number : 09-041675
(22)Date of filing : 10.02.1997

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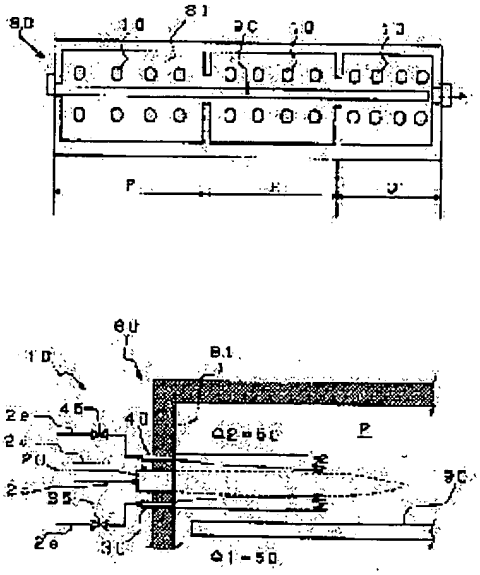
(54) CONTINUOUS HEATING FURNACE

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a continuous heating furnace capable of keepting the side nearer to steel slab in optimum atmosphere in accordance with heating purpose.
SOLUTION: Burners 10 are arranged on the furnace wall 81 in a heating zone 1P, heating zone 2H and heating zone 3U divided in the moving direction of the steel slab 90. Each burner 10 is provided with an air injecting hole 20 capable of injecting the preheated air ≥800° C, or the preheated air at ≥800° C and primary fuel, a proximity fuel injecting hole 30 and a remote fuel injecting hole 40 arranged at the position nearer to and away from the steel slab 90 to/from the injecting hole 20 and capable of injecting a secondary fuel, a first adjusting value 35 attached to the proximity fuel injecting hole 30 and a second adjusting valve 45 attached to the remote fuel injecting hole 40. In the heating zone 1P, the fuel supply quantity to the proximity fuel injecting hole 30 is made almost equal to that to the remote fuel injecting hole 40, and in the heating zone 2H, the fuel supply quantity to the injecting hole 30 is made almost equal to that to the remote fuel injecting hole 40, and in the heating zone 3U, the fuel supply quantity to the injecting hole 30 is made smaller than that to the injecting hole 40.



LEGAL STATUS

[Date of request for examination] 19.11.1998
[Date of sending the examiner's decision of rejection]
[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]
[Date of final disposal for application]
[Patent number] 3184774

[Date of registration] 27.04.2001
[Number of appeal against examiner's decision of rejection]
[Date of requesting appeal against examiner's decision of rejection]
[Date of extinction of right]

CLAIMS

[Claim(s)]
[Claim 1] The inside of one furnace body is divided in two or more bands, and at least one burner is arranged by the furnace wall of each of that band. each of the burner The tempered air 800 degrees C or more Or the air exhaust nozzle which can inject the tempered air and primary fuel 800 degrees C or more, The proximity fuel-injection mouth and remote fuel-injection mouth which were prepared in the side close to a slab, and far to the air exhaust nozzle and which can inject secondary fuel, respectively, While having the 1st control valve attached to the proximity fuel-injection mouth, and the 2nd control valve attached to the remote fuel-injection mouth Through the 1st control valve and the 2nd control valve, in the band of the carrying-in mouth of a slab, the amount of fuel supply to a proximity fuel-injection mouth spreads abbreviation etc. on it to a remote fuel-injection mouth, and it is set up. It is set up so that the amount of fuel supply to a proximity fuel-injection mouth may be made larger than that to a remote fuel-injection mouth in the band inserted into the band of the carrying-in mouth of a slab, and the band of a taking-out mouth and a slab may be heated by the reducing atmosphere. The continuous heating furnace characterized by being set up so that the amount of fuel supply to a proximity fuel-injection mouth may be made smaller than that to a remote fuel-injection mouth in the band of the taking-out mouth of a slab and a slab may be heated by the oxidizing atmosphere.
[Claim 2] The inside of one furnace body is divided in two or more bands, and at least one burner is arranged by the furnace wall of each of that band. each of the burner The tempered air 800 degrees C or more Or the air exhaust nozzle which can inject the tempered air and primary fuel 800 degrees C or more, The contiguity fuel-injection mouth and remote fuel-injection mouth which were prepared in the side close to a slab, and far to the air exhaust nozzle and which can inject secondary fuel, respectively, While having the rate control valve of a fuel-supply quantitative ratio attached to the contiguity fuel-injection mouth and the remote fuel-injection mouth Through the rate control valve of a fuel-supply quantitative ratio, in the band of the carrying-in mouth of a slab, the amount of fuel supply to a contiguity fuel-injection mouth spreads abbreviation etc. on it to a remote fuel-injection mouth, and it is set up. It is set up so that the amount of fuel supply to a contiguity fuel-injection mouth may be made larger than that to a remote fuel-injection mouth in the band inserted into the band of the carrying-in mouth of a slab, and the band of a taking-out mouth and a slab may be heated by the reducing atmosphere. The continuous heating furnace characterized by being set up so that the amount of fuel supply to a contiguity fuel-injection mouth may be made smaller than that to a remote fuel-injection mouth in the band of the taking-out mouth of a slab and a slab may be heated by the oxidizing atmosphere.
[Claim 3] The continuous heating furnace according to claim 1 or 2 characterized by setting up the position of the burner of each band so that the distance of the center of the burner for two or more aforementioned bands of every and a slab may be applied to the band of a taking-out mouth from the band of the carrying-in mouth of a slab and it may become large.
[Claim 4] It is [the claim 1 characterized by either of the aforementioned burners arranged so that a pair may be made to a furnace wall while the excess air ratio of the aforementioned whole burner was held at the value slightly higher than 1 working, and another side stopping, stopping on the contrary

subsequently, and that another side works setting a predetermined time interval, and being repeated by turns or] a continuous heating furnace given in either among 3.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention relates the amount of heat transfer and atmosphere over a slab to the thing it was made to become the optimal for every band about the continuous heating furnace for which it is divided in two or more heating zone regions, and the tempered air 800 degrees C or more is used.
[0002]
[Description of the Prior Art] The continuous heating furnace 1 is divided in two or more heating zone regions, such as heating zone 3U which hits the band of the taking-out mouth of heating zone 2H and a slab which hits the band inserted into the band of the carrying-in mouth of heating zone 1P and a slab 90 which hits the band of the carrying-in mouth of a slab 90, and the band of a taking-out mouth, as shown in drawing 11 . in recent years In order to raise the thermal efficiency, the thing equipped with the burner 2 which the tempered air 800 degrees C or more is used [burner], and burns fuel came to be used. The burner 2 For example, air exhaust nozzle 2a which injects 800 degrees C or more tempered air 2c prepared in furnace wall 1a as shown in drawing 12 , It has two or more fuel-injection mouth 2b prepared in the circumference., respectively 2d of primary fuel, Air exhaust nozzle 2a and fuel-injection mouth 2b are supplied, secondary fuel 2e also mixes the fuel injected from which mouth with tempered air 2c injected from air exhaust nozzle 2a, and burns, and a flame is formed, and it is constituted so that a slab 90 may be heated by the heat to generate.
[0003] Moreover, in the conventional continuous heating furnace 1, the physical relationship over the slab 90 of air exhaust nozzle 2a which constitutes a burner 2, and fuel-injection mouth 2b is the same in any band, and air exhaust nozzle 2a and fuel-injection mouth 2b are arranged so that a flame may not contact a slab 90. It is constituted so that fuel may moreover be equally supplied to all of fuel-injection mouth 2b prepared in the side close to a slab 90, and far.
[0004]
[Problem(s) to be Solved by the Invention] However, the yield of the non-burned component in exhaust gas increases, and since an excess air ratio is held at a value smaller than 1, if it is emitted into the atmosphere as it is, it will produce the problem of polluting environment, as a whole, for example, so that a reducing atmosphere may be formed for the purpose of suppression of generation of the scale of the front face of a slab 90. Moreover, in order to avoid the environmental problem, it is necessary to form separately the burner which burns a non-burned component.
[0005] On the other hand, if an excess air ratio is held as a whole at a high value more remarkable than 1, while the amount of combustion gases by the excess air will increase and thermal efficiency will fall, there is a trouble that generation of the scale of the front face of a slab 90 increases.
[0006] Then, the place made into the purpose of this invention is to offer the continuous heating furnace constituted so that the side near the slab which affects it substantially to a slab might moreover be held for every band at the optimal atmosphere, without thermal efficiency being high, and there being almost no yield of the non-burned component in exhaust gas, therefore polluting environment.
[0007]

[Means for Solving the Problem] Since the above-mentioned purpose is attained, the continuous heating furnace of invention of a claim 1 The heating zone 1 which the inside of one furnace body is divided in two or more bands, for example, hits three bands and the band of the carrying-in mouth of a slab (90) (P), If the case of the heating zone 2 (H) which hits the band inserted into the band of the carrying-in mouth of a slab (90) and the band of a taking-out mouth, and heating zone [which hits the band of the taking-out mouth of a slab (90)] 3 (U) , is assumed At least one burner (10) is arranged by the furnace wall of each of that band. each of the burner (10) The tempered air 800 degrees C or more (2c) Or the air exhaust nozzle which can inject the tempered air (2c) and primary fuel (2d) 800 degrees C or more (20), The contiguity fuel-injection mouth (30) and remote fuel-injection mouth (40) which were prepared in the side close to a slab (90), and far to the air exhaust nozzle (20) and which can inject secondary fuel (2e), respectively, While having the 1st control valve (35) attached to the contiguity fuel-injection mouth (30), and the 2nd control valve (45) attached to the remote fuel-injection mouth (40) Through the 1st control valve (35) and the 2nd control valve (45), in the heating zone 1 (P) of the carrying-in mouth of a slab (90), the amount of fuel supply to a contiguity fuel-injection mouth (30) spreads abbreviation etc. on it to a remote fuel-injection mouth (40), and it is set up. It is set up so that the amount of fuel supply to a contiguity fuel-injection mouth (30) may be made larger than that to a remote fuel-injection mouth (40) in the heating zone 2 (H) inserted into the band of the carrying-in mouth of a slab (90), and the band of a taking-out mouth and a slab (90) may be heated by the reducing atmosphere. It is characterized by being set up so that the amount of fuel supply to a contiguity fuel-injection mouth (30) may be made smaller than that to a remote fuel-injection mouth (40) in the heating zone 3 (U) of the taking-out mouth of a slab (90) and a slab (90) may be heated by the oxidizing atmosphere.

[0008] The continuous heating furnace of invention of a claim 2 is divided in the band (P, H, U) of plurality [inside / of one furnace body]. At least one burner (10) is arranged by the furnace wall of each of that band (P, H, U). each of the burner (10) The tempered air 800 degrees C or more (2c) Or the air exhaust nozzle which can inject the tempered air (2c) and primary fuel (2d) 800 degrees C or more (20), The contiguity fuel-injection mouth (30) and remote fuel-injection mouth (40) which were prepared in the side close to a slab (90), and far to the air exhaust nozzle (20) and which can inject secondary fuel (2e), respectively, While having the rate control valve of a fuel-supply quantitative ratio (55) attached to the contiguity fuel-injection mouth (30) and the remote fuel-injection mouth (40) Through the rate control valve of a fuel-supply quantitative ratio (55), in the band (P) of the carrying-in mouth of a slab (90), the amount of fuel supply to a contiguity fuel-injection mouth (30) spreads abbreviation etc. on it to a remote fuel-injection mouth (40), and it is set up. It is set up so that the amount of fuel supply to a contiguity fuel-injection mouth (30) may be made larger than that to a remote fuel-injection mouth (40) in the band (H) inserted into the band (P) of the carrying-in mouth of a slab (90), and the band (U) of a taking-out mouth and a slab (90) may be heated by the reducing atmosphere. It is characterized by being set up so that the amount of fuel supply to a contiguity fuel-injection mouth (30) may be made smaller than that to a remote fuel-injection mouth (40) in the band (U) of the taking-out mouth of a slab (90) and a slab (90) may be heated by the oxidizing atmosphere. Oils, such as gas, and a fuel oil, lamp oil, are contained in primary fuel given in the above-mentioned claims 1 and 2, and secondary fuel.

[0009] Moreover, the continuous heating furnace of invention of a claim 3 is added to the composition of a claim 1 or invention of two. The center of two or more burners (10) of every band (P, H, U), and distance (L1, L2, L3) with a slab (90) It is characterized by what (L1<L2<L3) the position of the burner (10) of each band was set up for so that it might apply to the band (U) of a taking-out mouth from the band (P) of the carrying-in mouth of a slab (90) and might become large.

[0010] Furthermore, while the excess air ratio of the whole burner (10) is held at a value slightly higher than 1 in addition to the composition of invention according to claim 1, 2, or 3, the continuous heating furnace of invention of a claim 4 Either of the burners (10 10) arranged so that a pair may be made to a furnace wall (81 81) works, another side stops, subsequently it stops on the

contrary, and it is characterized by setting a predetermined time interval and being repeated by turns that another side works. In addition, it is the ratio of the air content over the theoretical air content for carrying out the perfect combustion of the fuel, and although the value with the value slightly higher than 1 changes a little with kinds of fuel, there is no generating of a non-burned component substantially, and an excess air ratio is a value from which the amount of combustion gases serves as the minimum, and is about 1.05 in gaseous fuel. In addition, in order to arrange a burner so that a pair may be made to a furnace wall, what [not only] is arranged so that a pair may be made, respectively to the parallel furnace wall which faces on both sides of the heated body but the thing which adjoins one of furnace walls (both are sufficient) among parallel furnace walls, and is arranged is contained.

[0011] The sign in the parenthesis indicated by the above-mentioned The means for solving a technical problem is equivalent to the sign indicated by the drawing and the gestalt of implementation of invention mentioned later.

[0012] According to invention according to claim 1 or 2, the temperature of the near flame of the contiguity fuel-injection mouth near a slab is high, first, in the band 1 of the carrying-in mouth of a slab, for example, a heating zone, the amount of fuel supply to a contiguity fuel-injection mouth spreads abbreviation etc., and is set as it to a remote fuel-injection mouth, since a temperature gradient with a slab is also large, the amount of heat transfer to a slab is high, and the temperature of a slab rises abruptly. Next, in the band 2 inserted into the band of the carrying-in mouth of a slab, and the band of a taking-out mouth, for example, a heating zone, since the amount of fuel supply to a contiguity fuel-injection mouth is larger than that to a remote fuel-injection mouth, the temperature of the near flame of the contiguity fuel-injection mouth near a slab is high, since a temperature gradient with a slab is also large, the amount of heat transfer to a slab is high, and the temperature of a slab rises. And since the near air contents of the contiguity fuel-injection mouth near a slab run short, a non-burned component occurs and it becomes a reducing atmosphere, generation of the scale of the front face of a slab is suppressed. Since the amount of fuel supply to a contiguity fuel-injection mouth is smaller than that to a remote fuel-injection mouth, although the temperature of the near flame of the contiguity fuel-injection mouth near a slab is low, the amount of heat transfer to a slab is low since a temperature gradient with a slab is also small and the temperature on the front face of a slab finally hardly goes up in the band 3 of the taking-out mouth of a slab, for example, a heating zone, equalization of internal and external temperature progresses. The near air content of a contiguity fuel-injection mouth becomes superfluous, the circumference of a slab serves as an oxidizing atmosphere, it is thin, the scale which was generated on the slab front face by the zone of preparatory heating and the heating zone and which cannot exfoliate easily oxidizes, and the detachability is raised.

[0013] Moreover, the case of a flame length of the band of the carrying-in mouth of the set-up slab with which the amount of fuel supply to a contiguity fuel-injection mouth spreads abbreviation etc. on it to a remote fuel-injection mouth is the shortest, and it will become as long as what has the larger amount of fuel supply to a contiguity fuel-injection mouth than that to a remote fuel-injection mouth or a small thing.

[0014] On the other hand, although a non-burned component once generates partially the region where the amount of fuel supply is large by setting up the air content to which any band is supplied from an air exhaust nozzle so that an excess air ratio may become large slightly from 1 as the whole burner, mixture with air progresses toward the nose of cam of a flame, and, finally it burns completely. Therefore, there are also few amounts of combustion gases, thermal efficiency is high, and environment is not polluted.

[0015] According to invention according to claim 3, since an excess air ratio is held at a value slightly higher than 1 in addition to the operation effect of invention according to claim 1 or 2, thermal efficiency is high. Since the distance of the flame and slab which are formed in the contiguity fuel-injection mouth side of a heating zone 1 is small, while the distance of the center of a burner and a slab is missing from the band of a taking-out mouth from the band of the carrying-in mouth of a slab, for example, large in order of the heating zone 1, the heating zone 2, and the heating zone 3, and the amount of heat transfer to the slab in a heating zone 1 moreover becomes

large, temperature rise speed becomes large. Since the flame formed in the remote fuel-injection mouth side of a heating zone 3 on the contrary becomes far from a slab, it becomes close to a ceiling and the heat is reflected in [whole] a furnace at the ceiling, the heat transfer unevenness to a slab decreases and the temperature of a slab is equalized.
[0016] According to invention according to claim 4, it adds to the operation effect of invention according to claim 1, 2, or 3. Since either of the burners used as a pair works and a burner works at the so-called police box which another side stops and subsequently stops on the contrary, and that another side works sets a predetermined time interval, and is repeated by turns The uneven heating of the cross direction of a slab is equalized and the heating unevenness of a slab is canceled.
[0017]
[Embodiments of the Invention] The example of a gestalt of operation of this invention is explained with reference to a drawing. Drawing of longitudinal section showing the continuous heating furnace concerning the example of a gestalt of operation of the 1st of this invention in drawing 1 , the cross-sectional view in which drawing 2 shows a part of heating zone 1P of drawing 1 , the cross-sectional view in which drawing 3 shows a part of heating zone 2H of drawing 1 , and drawing 4 are the cross-sectional views showing a part of soaking-zone 3U of drawing 1 .
[0018] The continuous heating furnace 80 concerning the example of a gestalt of operation of the 1st of this invention is divided in three bands of heating zone 1P which heat a slab 90 beforehand in the move direction of a slab 90, heating zone 2H which heat a slab 90 by the reducing atmosphere, heating zone 3U which heats a slab 90 by the oxidizing atmosphere and equalizes the temperature in a slab 90, and. And the burner 10 constituted as follows by the method of the upper and lower sides of the furnace wall 81 of each of that band and a slab 90 is arranged. Namely, 800 degrees C or more tempered air 2c Or it centers on the air exhaust nozzle 20 (you may prepare two or more air exhaust nozzles in this level) which can inject 800 degrees C or more tempered air 2c and 2d of primary fuel. The remote fuel-injection mouth 40 which can inject the same secondary fuel 2e is arranged at the side with the contiguity fuel-injection mouth 30 far from a slab 90 which can inject secondary fuel 2e to the side near a slab 90, respectively. Moreover, the 1st control valve 35 which can adjust the amount of fuel supply is attached to the contiguity fuel-injection mouth 30 (you may prepare two or more contiguity fuel-injection mouths in this level), and the 2nd control valve 45 which can adjust the amount of fuel supply is attached to the remote fuel-injection mouth 40 (you may prepare two or more remote fuel-injection mouths in this level). As primary fuel and secondary fuel, the ** part of the oils, such as gas, and a fuel oil, lamp oil, is carried out. In addition, 800 degrees C or more tempered air 2c can be obtained by using an accumulation formula burner, a thermal accumulator, or a recuperator.
[0019] Furthermore, the relation between the amount Q1 of fuel supply to the contiguity fuel-injection mouth 30 of each band and the amount Q2 of fuel supply to the remote fuel-injection mouth 40 is set up as follows through the 1st and the 2nd control valve 35 and 45 which can be adjusted separately. Heating zone 1P namely, the amount Q1 of fuel supply to the contiguity fuel-injection mouth 30 Abbreviation etc. is spread and set as the amount Q2 of fuel supply to the remote fuel-injection mouth 40. heating zone 2H the amount Q1 of fuel supply to the contiguity fuel-injection mouth 30 It is set up so that it may become larger than the amount Q2 of fuel supply to the remote fuel-injection mouth 40, and heating zone 3U is set up so that the amount Q1 of fuel supply to the contiguity fuel-injection mouth 30 may become smaller than the amount Q2 of fuel supply to the remote fuel-injection mouth 40. In addition, even if automatic, manual may be used for the 1st and an opening setup (0-100) of the 2nd control valve 35 and 45, and you may make it control them by the controller for example, according to combustion conditions.
[0020] if it explains concretely, in the entrance side of heating zone 1P, the amount Q1 of fuel supply to the contiguity fuel-injection mouth 30 is equal to it Q2 to the remote fuel-injection mouth 40 first (for example, Q1:Q2=50:50) -- it needs -- since it is set up, the temperature of the near flame of the contiguity fuel-injection mouth 30 near a slab 90 is high, and a temperature gradient with a slab 90 is also large For this reason, the amount of heat

transfer to a slab 90 is high, and the temperature of a slab 90 rises rapidly. In addition, for a low reason, in this region, generation of the scale has little temperature of a slab 90 in comparison. Moreover, a flame length is short as compared with heating zone 2H and heating zone 3U which are mentioned later.

[0021] furthermore, in the side near heating zone 2H in which the temperature of a slab 90 carried out remarkable elevation the amount Q1 of fuel supply to the contiguity fuel-injection mouth 30 is larger than that [Q2] to the remote fuel-injection mouth 40 (for example, Q1:Q2=100:0) -- it needs, since it is set up While the near air contents of the contiguity fuel-injection mouth 30 run short, the rate of combustion falls, a flame becomes long and the temperature falls, fuel serves as incomplete combustion and a non-burned component generates it. Although the temperature of this flame is low, the degree of radiation is high, since it is close to a slab 90, the amount of heat transfer is comparatively high, and it reaches for a short time at desired temperature. However, for a low reason, the attainment temperature is low, it is overheated and a flame temperature does not cause melting etc. And since atmosphere serves as reducing, generation of the scale is also suppressed. however, the air content supplied from the air exhaust nozzle 20 -- the burner 10 whole -- ** -- since it is supplied so that an excess air ratio may become large slightly from 1 if it carries out, although a non-burned component once occurs partially in the contiguity fuel-injection mouth 30 side, mixture with air progresses toward the nose of cam of a flame, and, finally it burns completely Therefore, there are also few amounts of combustion gases, thermal efficiency is high, and environment is not polluted. In addition, you may supply little primary fuel to the air exhaust nozzle 20 for combustion stabilization. although it operated as Q1:Q2=100:0 in drawing 3 -- 80: -- it can be set as arbitration, such as 20 and 70:30 Moreover, you may gather the ratio of Q1 and Q2 gradually with Q1:Q2=50:50 to 60:40, 70:30, 80:20, and 90:10,100:100 as it is set to heating zone 2H from heating zone 1P.

[0022] Next, in heating zone 2H, since the amount Q1 of fuel supply to the contiguity fuel-injection mouth 30 is larger than that [Q2] to the remote fuel-injection mouth 40 (for example, Q1:Q2=100:0), the temperature and the degree of radiation of the near flame of the contiguity fuel-injection mouth 30 near a slab 90 are high, since a temperature gradient with a slab 90 is also large, the amount of heat transfer to a slab 90 is high, and the temperature of a slab 90 rises And since the near air contents of the contiguity fuel-injection mouth 30 near a slab 90 run short, a non-burned component occurs and it becomes a reducing atmosphere, generation of the scale of the front face of a slab 90 is suppressed. Moreover, a flame becomes long.

[0023] Finally it sets to heating zone 3U. Since the amount Q1 of fuel supply to the contiguity fuel-injection mouth 30 is smaller than that [Q2] to the remote fuel-injection mouth 40 (for example, Q1:Q2=0:100), Although the temperature of the near flame of the contiguity fuel-injection mouth 30 near a slab 90 is low, the amount of heat transfer to a slab 90 is low since a temperature gradient with a slab 90 is also small, and the skin temperature of a slab 90 hardly goes up, equalization of internal and external temperature progresses. Moreover, it becomes long like heating zone 2H. And the near air content of the contiguity fuel-injection mouth 30 becomes superfluous, the circumference of a slab 90 serves as an oxidizing atmosphere, it is thin, the scale which was generated on slab 90 front face by heating zone 1P and heating zone 2H and which cannot exfoliate easily oxidizes, and the detachability is raised. On the other hand, since the flame formed in the remote fuel-injection mouth 40 side is reflected in near at the ceiling and the heat is reflected by the long distance from a slab 90, and the ceiling in [whole] a furnace, the heat transfer unevenness to a slab 90 decreases, and soaking-ization of a slab 90 is promoted.

[0024] In addition, although a non-burned component once generates partially the region where the amount of fuel supply is large by being set up so that an excess air ratio may become [the air content to which any band is supplied from the air exhaust nozzle 20 as mentioned above] slightly and large from 1 as the burner 10 whole, mixture with air progresses toward the nose of cam of a flame, and finally it burns completely. Therefore, there are also few amounts of combustion gases, thermal efficiency is high, and environment is not polluted.

[0025] Next, in addition to the composition of the example of a gestalt of the 2nd operation of a ****, if drawing 5 or drawing 8 explains the example of a gestalt of the 2nd operation, as shown in drawing 5 The relation between the distance L1 of the center of a burner 10 and slab 90 in heating zone 1P, the distance L2 of the center of a burner 10 and slab 90 in heating zone 2H, and the distance L3 of the center of a burner 10 and slab 90 in heating zone 3U The position (height) of the burner 10 in each band is set up so that it may be set to L1<L2<L3. it -- the above-mentioned operation effect -- in addition -- since the distance of the flame and slab 90 which are formed in the contiguity fuel-injection mouth 30 side of heating zone 1P is small, while the amount of heat transfer to the slab 90 in heating zone 1P becomes large -- temperature rise speed -- being large -- the time which a preheating or heating takes is shortened Moreover, since the flame formed in the remote fuel-injection mouth 40 side of heating zone 3U on the contrary becomes far from a slab 90, it becomes close to a ceiling and the heat is reflected in [whole] a furnace at the ceiling, the heat transfer unevenness to a slab 90 decreases, and equalization of the temperature of a slab 90 is promoted.
[0026] Next, if drawing 9 explains the example of a gestalt of the 3rd operation, the furnace walls 81 and 81 parallel to the move direction of the slab 90 of the above-mentioned continuous heating furnace 80 which face are faced mutually, respectively, and burners 10 and 10 are arranged so that a pair may be made. And combustion heating conditions are set up as follows so that the operation of burners 10 and 10 which faces, and a pause may set a predetermined time interval and may be repeated by turns, namely, so that one burner 10 may work to a police box. That is, either of the burners 10 and 10 which faces carries out fixed time operation, air and fuel are injected toward the furnace wall 81 of another side from one furnace wall 81, and another side stops in the meantime. subsequently, a burner 10 worked [while] on the contrary and is the same -- a time pause is carried out, another side works in the meantime, and air and fuel are injected toward one furnace wall 81 from the furnace wall 81 of another side In addition, the excess air ratio of each whole burner 10 is held at a value slightly higher than 1.
[0027] Although the flame formed by each burner 10 changes with setup of the combustion condition, respectively, from the furnace wall 81 of the side by which air and fuel are injected, toward the furnace wall 81 which faces, temperature and a configuration, atmosphere, etc. change and it has a characteristic distribution for all. Therefore, crosswise heating to a slab 90 is not uniform, and there is a possibility that heating unevenness may arise. Since the distribution of temperature and a configuration, atmosphere, etc. sets a predetermined time interval, it becomes a retrose and the uneven heating of the cross direction of a slab 90 is equalized by being set up so that the operation of burners 10 and 10 which faces, and a pause may set a predetermined time interval and may be repeated by turns to it, the heating unevenness of a slab 90 is canceled. In addition, one of the furnace walls 81 (both are sufficient) is adjoined not only among what is arranged so that a pair may be made, respectively to the parallel furnace walls 81 and 81 which face burners 10 and 10 on both sides of the heated body 90 but among the parallel furnace walls 81 and 81, and you may make it arrange.
[0028] Drawing 10 explains the example of a gestalt of the 4th operation to the last. In the 1st mentioned above or the example of a gestalt of the 3rd operation, although the 1st control valve 35 which can be adjusted, and it attach independently the 2nd control valve 45 which can be adjusted if needed, respectively for the amount of fuel supply to the remote fuel-injection mouth 40, the amount of fuel supply to the contiguity fuel-injection mouth 30 As it changes to this and is shown in drawing 10 , use the rate control valve 55 of a fuel-supply quantitative ratio, it enables it to perform work of the 1st control valve 35 and the 2nd control valve 45 with one valve, and regulation of the ratio of the amount of fuel supply to the contiguity fuel-injection mouth 30 and the remote fuel-injection mouth 40 may be enabled if needed. The side near the heated body 90 which affects it substantially to the heated body 90 by it can be adjusted in an oxidizing quality or reducing (the thing of this middle nature is also included) arbitrary atmosphere. In addition, even if automatic, manual may be used for an opening setup (0-100) of the rate control valve 55 of a fuel-supply quantitative ratio, and you may make it control it by the controller for example, according to combustion conditions.

[0029] In addition, the continuous heating furnace 80 of this example of an operation gestalt was divided in the band of plurality [inside / of one furnace body]. Although explained supposing the case of heating zone 3U, which hits the band of the heating zone 2H and the taking-out mouth of a slab 90 which hit heating zone 1P which hit three bands, i.e., the band of the carrying-in mouth of a slab 90, as an example, and the band inserted into the band of the carrying-in mouth of a slab 90, and the band of a taking-out mouth Even the thing of two bands or four bands or more is applied without being restricted to especially this.

EFFECT OF THE INVENTION

[Effect of the Invention] Since the ratio to it to the remote fuel-injection mouth of the amount of fuel supply to a proximity fuel-injection mouth is set up proper for every band according to the heating purpose of a slab as above according to invention according to claim 1 or 2, While the amount of heat transfer according to the heating purpose of a slab is obtained, the atmosphere of the side near the slab which affects it substantially to a slab is held proper. And although a non-burned component once generates partially the region where the amount of fuel supply is large by setting up the air content to which any band is supplied from an air exhaust nozzle so that an excess air ratio may become large slightly from 1 as the whole burner, mixture with air progresses toward the nose of cam of a flame, and, finally it burns completely. Therefore, there are also few amounts of combustion gases, thermal efficiency is high, and environment is not polluted. A flame length can also be changed by changing the ratio to it to the remote fuel-injection mouth of the amount of fuel supply to a proximity fuel-injection mouth. Especially according to invention according to claim 2, since two control valves return to one rate control valve of a fuel-supply quantitative ratio, part mark are mitigated.
[0031] Since the distance of the center of a burner and a slab is set [according to invention according to claim 3] up proper for every band according to the heating purpose of a slab in addition to the operation effect of invention according to claim 1 or 2, While the optimal amount of heat transfer according to the heating purpose of a slab is obtained, the atmosphere of the side near the slab which affects it substantially to a slab is held the optimal.
[0032] According to invention according to claim 4, since an excess air ratio is held at a value slightly higher than 1 in addition to the operation effect of invention according to claim 1, 2, or 3, thermal efficiency is high. Since a burner moreover works at the so-called police box, the uneven heating of the cross direction of a slab is equalized and the heating unevenness of a slab is canceled.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is drawing of longitudinal section showing the continuous heating furnace concerning the example of a gestalt of operation of the 1st of this invention.
[Drawing 2] It is the cross-sectional view showing a part of heating zone 1P of drawing 1 .
[Drawing 3] It is the cross-sectional view showing a part of heating zone 2H of drawing 1 .
[Drawing 4] It is the cross-sectional view showing a part of heating zone 3U of drawing 1 .
[Drawing 5] It is drawing of longitudinal section showing the continuous heating furnace concerning the example of a gestalt of operation of the 2nd of this invention.
[Drawing 6] It is the cross-sectional view showing a part of heating zone 1P of drawing 5 .
[Drawing 7] It is the cross-sectional view showing a part of heating zone 2H of drawing 5 .
[Drawing 8] It is the cross-sectional view showing a part of heating zone 3U of drawing 5 .
[Drawing 9] It is the cross-sectional view showing a part of continuous heating furnace concerning the example of a gestalt of operation of the 3rd of this invention.
[Drawing 10] It is the cross-sectional view showing a part of continuous heating furnace concerning the example of a gestalt of operation of the 4th of this invention.
[Drawing 11] It is drawing of longitudinal section showing the conventional example.
[Drawing 12] It is the cross-sectional view showing a part of drawing 11 .
[Description of Notations]
1 Continuous Heating Furnace
1a Furnace wall
2 Burner
2a Air exhaust nozzle
2b Fuel-injection mouth
2c Air
2d Primary fuel
2e Secondary fuel
10 Burner
20 Air Exhaust Nozzle
30 Contiguity Fuel-Injection Mouth
35 1st Control Valve
40 Remote Fuel-Injection Mouth
45 2nd Control Valve
55 Rate Control Valve of Fuel-Supply Quantitative Ratio
80 Continuous Heating Furnace
81 Furnace Wall
90 Slab
L1 Distance
L2 Distance
L3 Distance
Q1 The amount of fuel supply

Q2 The amount of fuel supply
P Heating zone 1
H Heating zone 2
U Heating zone 3

[Translation done.]

(19)日本国特許庁（ＪＰ）　(12)公開特許公報（Ａ）　(11)特許出願公開番号

特開平10－219354

(43)公開日　平成10年(1998)８月18日

(51)Int.Cl.[6]	識別記号	ＦＩ	
Ｃ２１Ｄ　9/00	１０１	Ｃ２１Ｄ　9/00	１０１Ｇ
1/52		1/52	Ｒ
Ｆ２３Ｌ　15/02		Ｆ２３Ｌ　15/02	

審査請求　未請求　請求項の数４　ＦＤ　（全８頁）

(21)出願番号　特願平9－41675

(22)出願日　平成９年(1997)２月10日

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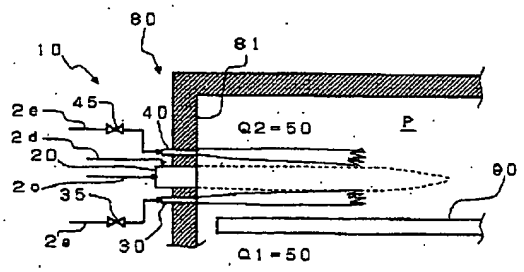
(54)【発明の名称】　連続加熱炉

(57)【要約】

【課題】　鋼片に近い側が加熱目的に応じて最適の雰囲気に保持される連続加熱炉を提供すること。

【解決手段】　鋼片９０の移動方向に区画された加熱帯１Ｐ，加熱帯２Ｈ，加熱帯３Ｕの炉壁８１にバーナ１０が配設され、バーナ１０の各々が、８００℃以上の予熱空気または、８００℃以上の予熱空気及び１次燃料を噴射可能な空気噴出口２０と，噴出口２０に対し鋼片９０に近い側と遠い側に設けられた、２次燃料を噴射可能な近接燃料噴射口３０と遠隔燃料噴射口４０と，近接燃料噴射口３０に付設された第１調節弁３５と，遠隔燃料噴射口４０に付設された第２調節弁４５と，を備え、加熱帯１Ｐでは近接燃料噴射口３０への燃料供給量が遠隔燃料噴射口４０へのそれに略等しく、加熱帯２Ｈでは噴射口３０への燃料供給量が噴射口４０へのそれより大きく、加熱帯３Ｕでは噴射口３０への燃料供給量が噴射口４０へのそれより小さく設定した。



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【特許請求の範囲】

【請求項１】１つの炉体内が複数の帯域に区画され、その各帯域の炉壁に少なくとも１つのバーナが配設され、そのバーナの各々が、８００℃以上の予熱空気または、８００℃以上の予熱空気及び１次燃料を噴射可能な空気噴出口と，その空気噴出口に対して、鋼片に近い側および遠い側に設けられた、それぞれ２次燃料を噴射可能な近接燃料噴射口および遠隔燃料噴射口と，近接燃料噴射口に付設された第１調節弁と，遠隔燃料噴射口に付設された第２調節弁と，を備えるとともに、第１調節弁および第２調節弁を介して、鋼片の搬入口の帯域においては近接燃料噴射口への燃料供給量が遠隔燃料噴射口へのそれに略等しく設定され、鋼片の搬入口の帯域と搬出口の帯域に挟まれた帯域においては近接燃料噴射口への燃料供給量が遠隔燃料噴射口へのそれよりも大きくされ還元性雰囲気で鋼片を加熱するよう設定され、鋼片の搬出口の帯域においては近接燃料噴射口への燃料供給量が遠隔燃料噴射口へのそれよりも小さくされ酸化性雰囲気で鋼片を加熱するよう設定されたことを特徴とする連続加熱炉。

【請求項２】１つの炉体内が複数の帯域に区画され、その各帯域の炉壁に少なくとも１つのバーナが配設され、そのバーナの各々が、８００℃以上の予熱空気または、８００℃以上の予熱空気及び１次燃料を噴射可能な空気噴出口と，その空気噴出口に対して、鋼片に近い側および遠い側に設けられた、それぞれ２次燃料を噴射可能な近接燃料噴射口および遠隔燃料噴射口と，近接燃料噴射口および遠隔燃料噴射口に付設された燃料供給量比率調節弁と，を備えるとともに、燃料供給量比率調節弁を介して、鋼片の搬入口の帯域においては近接燃料噴射口への燃料供給量が遠隔燃料噴射口へのそれに略等しく設定され、鋼片の搬入口の帯域と搬出口の帯域に挟まれた帯域においては近接燃料噴射口への燃料供給量が遠隔燃料噴射口へのそれよりも大きくされ還元性雰囲気で鋼片を加熱するよう設定され、鋼片の搬出口の帯域においては近接燃料噴射口への燃料供給量が遠隔燃料噴射口へのそれよりも小さくされ酸化性雰囲気で鋼片を加熱するよう設定されたことを特徴とする連続加熱炉。

【請求項３】前記複数の帯域毎のバーナの中心と鋼片との距離を、鋼片の搬入口の帯域から搬出口の帯域にかけて大きくなるように各帯域のバーナの位置が設定されたことを特徴とする請求項１又は２に記載の連続加熱炉。

【請求項４】前記バーナの全体の空気比が１より僅かに高い値に保持されると共に、炉壁に対をなすよう配置された前記バーナの、いずれか一方が稼動し、他方が休止し、次いで反対に一方が休止し、他方が稼動することが、所定の時間間隔をおいて交互に繰り返されることを特徴とする請求項１乃至３のうちいずれかに記載の連続加熱炉。

【発明の詳細な説明】

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【０００１】

【発明の属する技術分野】本発明は、複数の加熱帯域に区画され、且つ８００℃以上の予熱空気が用いられる連続加熱炉に関するものであって、鋼片に対する熱伝達量・雰囲気を帯域毎に最適になるようにしたものに関する。

【０００２】

【従来の技術】連続加熱炉１は、図１１に示すように、例えば鋼片９０の搬入口の帯域にあたる加熱帯１Ｐ・鋼片９０の搬入口の帯域と搬出口の帯域に挟まれた帯域にあたる加熱帯２Ｈ・鋼片の搬出口の帯域にあたる加熱帯３Ｕ等の複数の加熱帯域に区画されており、近年は、その熱効率を高めるために、８００℃以上の予熱空気を用いて燃料を燃焼させるバーナ２を備えたものが使用されるようになった。そのバーナ２は、例えば、図１２に示すように、炉壁１ａに設けられた８００℃以上の予熱空気２ｃを噴射する空気噴出口２ａと、その周囲に設けられた複数の燃料噴射口２ｂとを備え、それぞれ１次燃料２ｄ、２次燃料２ｅが、空気噴出口２ａ、燃料噴射口２ｂに供給され、何れの口から噴射された燃料も、空気噴出口２ａから噴射される予熱空気２ｃと混合し、燃焼し、火炎を形成し、その発生する熱によって鋼片９０が加熱されるよう構成されている。

【０００３】また従来の連続加熱炉１では、いずれの帯域でも、バーナ２を構成する空気噴出口２ａ、燃料噴射口２ｂの鋼片９０に対する位置関係が同一であり、しかも、空気噴出口２ａ、燃料噴射口２ｂは、鋼片９０に火炎が接触しないよう配置されている。そのうえ、鋼片９０に近い側、遠い側に設けられた燃料噴射口２ｂのいずれにも、均等に燃料が供給されるよう構成されている。

【０００４】

【発明が解決しようとする課題】しかしながら、例えば鋼片９０の表面の酸化スケールの生成の抑制を目的に、還元性雰囲気が形成されるよう、全体として空気比は１よりも小さい値に保持されるため、排ガス中の未燃焼成分の発生量が増加し、それがそのまま大気中に放出されると環境を汚染するという問題を生じる。また、その環境問題を避けるためには、未燃焼成分を燃焼するバーナを別個に設ける必要がある。

【０００５】他方、全体として空気比が１よりも著しく高い値に保持されると、過剰空気による燃焼排ガス量が増加し、熱効率が低下すると共に、鋼片９０の表面の酸化スケールの生成が増加するという問題点がある。

【０００６】そこで本発明の目的とするところは、熱効率が高く、排ガス中の未燃焼成分の発生量が殆ど無く、従って環境を汚染することもなく、そのうえ、帯域毎に、鋼片に対して実質的に影響を与える、鋼片に近い側が最適の雰囲気に保持されるよう構成された連続加熱炉を提供することにある。

【０００７】

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【課題を解決するための手段】上記の目的を達するために、請求項１の発明の連続加熱炉は、１つの炉体内が複数の帯域に区画され、例えば３帯域、鋼片（９０）の搬入口の帯域にあたる加熱帯１（Ｐ），鋼片（９０）の搬入口の帯域と搬出口の帯域に挟まれた帯域にあたる加熱帯２（Ｈ），鋼片（９０）の搬出口の帯域にあたる加熱帯３（Ｕ），の場合を想定すると、その各帯域の炉壁に少なくとも１つのバーナ（１０）が配設され、そのバーナ（１０）の各々が、８００℃以上の予熱空気（２ｃ）または、８００℃以上の予熱空気（２ｃ）及び１次燃料（２ｄ）を噴射可能な空気噴出口（２０）と，その空気噴出口（２０）に対して、鋼片（９０）に近い側および遠い側に設けられた、それぞれ２次燃料（２ｅ）を噴射可能な近接燃料噴射口（３０）および遠隔燃料噴射口（４０）と，近接燃料噴射口（３０）に付設された第１調節弁（３５）と，遠隔燃料噴射口（４０）に付設された第２調節弁（４５）と，を備えるとともに、第１調節弁（３５）および第２調節弁（４５）を介して、鋼片（９０）の搬入口の加熱帯１（Ｐ）においては近接燃料噴射口（３０）への燃料供給量が遠隔燃料噴射口（４０）へのそれに略等しく設定され、鋼片（９０）の搬入口の帯域と搬出口の帯域に挟まれた加熱帯２（Ｈ）においては近接燃料噴射口（３０）への燃料供給量が遠隔燃料噴射口（４０）へのそれよりも大きくされ還元性雰囲気で鋼片（９０）を加熱するよう設定され、鋼片（９０）の搬出口の加熱帯３（Ｕ）においては近接燃料噴射口（３０）への燃料供給量が遠隔燃料噴射口（４０）へのそれよりも小さくされ酸化性雰囲気で鋼片（９０）を加熱するよう設定されたことを特徴とするものである。

【０００８】請求項２の発明の連続加熱炉は、１つの炉体内が複数の帯域（Ｐ，Ｈ，Ｕ）に区画され、その各帯域（Ｐ，Ｈ，Ｕ）の炉壁に少なくとも１つのバーナ（１０）が配設され、そのバーナ（１０）の各々が、８００℃以上の予熱空気（２ｃ）または、８００℃以上の予熱空気（２ｃ）及び１次燃料（２ｄ）を噴射可能な空気噴出口（２０）と，その空気噴出口（２０）に対して、鋼片（９０）に近い側および遠い側に設けられた、それぞれ２次燃料（２ｅ）を噴射可能な近接燃料噴射口（３０）および遠隔燃料噴射口（４０）と，近接燃料噴射口（３０）および遠隔燃料噴射口（４０）に付設された燃料供給量比率調節弁（５５）と，を備えるとともに、燃料供給量比率調節弁（５５）を介して、鋼片（９０）の搬入口の帯域（Ｐ）においては近接燃料噴射口（３０）への燃料供給量が遠隔燃料噴射口（４０）へのそれに略等しく設定され、鋼片（９０）の搬入口の帯域（Ｐ）と搬出口の帯域（Ｕ）に挟まれた帯域（Ｈ）においては近接燃料噴射口（３０）への燃料供給量が遠隔燃料噴射口（４０）へのそれよりも大きくされ還元性雰囲気で鋼片（９０）を加熱するよう設定され、鋼片（９０）の搬出口の帯域（Ｕ）においては近接燃料噴射口（３０）への

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燃料供給量が遠隔燃料噴射口（４０）へのそれよりも小さくされ酸化性雰囲気で鋼片（９０）を加熱するよう設定されたことを特徴とするものである。上記請求項１および２に記載の１次燃料，２次燃料には例えばガスや重油，灯油等の油が含まれる。

【０００９】また請求項３の発明の連続加熱炉は、請求項１又は２の発明の構成に加えて、複数の帯域（Ｐ，Ｈ，Ｕ）毎のバーナ（１０）の中心と鋼片（９０）との距離（Ｌ１，Ｌ２，Ｌ３）を、鋼片（９０）の搬入口の帯域（Ｐ）から搬出口の帯域（Ｕ）にかけて大きくなるように各帯域のバーナ（１０）の位置が設定された（Ｌ１＜Ｌ２＜Ｌ３）ことを特徴とするものである。

【００１０】更に請求項４の発明の連続加熱炉は、請求項１，２又は３に記載の発明の構成に加えて、バーナ（１０）の全体の空気比が１より僅かに高い値に保持されると共に、炉壁（８１，８１）に対をなすよう配置されたバーナ（１０，１０）の、いずれか一方が稼動し、他方が休止し、次いで反対に一方が休止し、他方が稼動することが、所定の時間間隔をおいて交互に繰り返されることを特徴とする。なお、空気比とは、燃料を完全燃焼させるための理論的空気量に対する空気量の比率であり、その値が１より僅かに高い値とは、燃料の種類によって若干異なるが、未燃焼成分の発生が実質的に皆無で、燃焼排ガス量が最小限となる値であり、気体燃料では１．０５程度である。なお、バーナを炉壁に対をなすよう配置するには、被加熱体を挟んで相対する平行な炉壁にそれぞれ対をなすよう配置するものだけでなく、平行な炉壁のうちいずれか一方の炉壁（両方でもよい）に隣接して配置するものも含まれる。

【００１１】上記の課題を解決するための手段に記載された括弧内の記号は図面及び後述する発明の実施の形態に記載された記号に対応するものである。

【００１２】請求項１又は２に記載の発明によれば、先ず鋼片の搬入口の帯域、例えば加熱帯１においては、近接燃料噴射口への燃料供給量が、遠隔燃料噴射口へのそれに略等しく設定され、鋼片に近い近接燃料噴射口の側の火炎の温度が高く、鋼片との温度差も大きいため、鋼片への熱伝達量が高く、鋼片の温度は急上昇する。次に鋼片の搬入口の帯域と搬出口の帯域に挟まれた帯域、例えば加熱帯２においては、近接燃料噴射口への燃料供給量が、遠隔燃料噴射口へのそれよりも大きいため、鋼片に近い近接燃料噴射口の側の火炎の温度が高く、鋼片との温度差も大きいため、鋼片への熱伝達量が高く、鋼片の温度は上昇する。しかも、鋼片に近い近接燃料噴射口の側の空気量が不足し、未燃焼成分が発生し、還元性雰囲気となるため、鋼片の表面の酸化スケールの生成は抑制される。最後に鋼片の搬出口の帯域、例えば加熱帯３においては、近接燃料噴射口への燃料供給量が、遠隔燃料噴射口へのそれよりも小さいため、鋼片に近い近接燃料噴射口の側の火炎の温度が低く、鋼片との温度差も小

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さいため、鋼片への熱伝達量が低く、鋼片表面の温度は殆ど上がらないが、内外の温度の均一化が進む。近接燃料噴射口の側の空気量が過剰となり、鋼片の周囲は酸化性雰囲気となり、予熱帯、加熱帯で鋼片表面に生成した薄く、剥離し難い酸化スケールが酸化され、その剥離性が高められる。

【００１３】また火炎の長さは近接燃料噴射口への燃料供給量が、遠隔燃料噴射口へのそれに略等しく設定された鋼片の搬入口の帯域の場合が最も短く、近接燃料噴射口への燃料供給量が、遠隔燃料噴射口へのそれよりも大きいもの、あるいは小さいもの程、長いものとなる。

【００１４】他方、いずれの帯域も、空気噴出口より供給される空気量が、バーナ全体としては空気比が１より僅かに大きくなるよう設定されることにより、燃料供給量が大きい域は、部分的に未燃焼成分が一旦発生するが、火炎の先端に向かって空気との混合が進み、最終的には完全燃焼する。そのため、燃焼排ガス量も少なく、熱効率が高く、環境を汚染することもない。

【００１５】請求項３に記載の発明によれば、請求項１又は２に記載の発明の作用効果に加えて、空気比が１より僅かに高い値に保持されるので熱効率が高い。そのうえ、バーナの中心と鋼片との距離が、鋼片の搬入口の帯域から搬出口の帯域にかけて、例えば加熱帯１，加熱帯２，加熱帯３の順に大きくなっていて、加熱帯１の近接燃料噴射口の側に形成される火炎と鋼片との距離が小さいため、加熱帯１における鋼片への熱伝達量が大きくなると共に、温度上昇速度が大きくなる。反対に加熱帯３の遠隔燃料噴射口の側に形成される火炎が、鋼片からは遠くなり、天井に近くなり、その熱が天井で炉内全体に反射されるため、鋼片への熱伝達むらが少なくなり、鋼片の温度が均一化される。

【００１６】請求項４に記載の発明によれば、請求項１，２又は３に記載の発明の作用効果に加えて、対となるバーナの、いずれか一方が稼動し、他方が休止し、次いで反対に一方が休止し、他方が稼動することが、所定の時間間隔をおいて交互に繰り返される、いわゆる交番でバーナが稼動されるので、鋼片の幅方向の不均一加熱が平準化され、鋼片の加熱むらが解消される。

【００１７】

【発明の実施の形態】本発明の実施の形態例について図面を参照して説明する。図１は本発明の第１の実施の形態例に係わる連続加熱炉を示す縦断面図、図２は図１の加熱帯１Ｐの一部分を示す横断面図、図３は図１の加熱帯２Ｈの一部分を示す横断面図、図４は図１の均熱帯３Ｕの一部分を示す横断面図である。

【００１８】本発明の第１の実施の形態例に係わる連続加熱炉８０は、鋼片９０の移動方向に、鋼片９０を予熱する加熱帯１Ｐと，鋼片９０を還元性雰囲気で加熱する加熱帯２Ｈと，鋼片９０を酸化性雰囲気で加熱し鋼片９０内の温度を均一化する加熱帯３Ｕと，の３帯域に区画

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されている。しかも、その各帯域の炉壁８１、鋼片９０の上下方に、以下のように構成されるバーナ１０が配設されている。すなわち、８００℃以上の予熱空気２ｃまたは、８００℃以上の予熱空気２ｃ及び１次燃料２ｄを噴射可能な空気噴出口２０（同レベルに複数の空気噴出口を設けてもよい）を中心にして、鋼片９０に近い側に、２次燃料２ｅを噴射可能な近接燃料噴射口３０が、鋼片９０から遠い側に、同じ２次燃料２ｅが噴射可能な遠隔燃料噴射口４０がそれぞれ配置されている。そのうえ近接燃料噴射口３０（同レベルに複数の近接燃料噴射口を設けてもよい）には燃料供給量を調節可能な第１調節弁３５が付設され、遠隔燃料噴射口４０（同レベルに複数の遠隔燃料噴射口を設けてもよい）には燃料供給量を調節可能な第２調節弁４５が付設されている。１次燃料，２次燃料としては例えばガスや重油，灯油等の油が使分される。なお８００℃以上の予熱空気２ｃは蓄熱式バーナ，蓄熱器，あるいは換熱器などを使用することによって得ることができる。

【００１９】さらに、別々に調節しうる第１，第２調節弁３５，４５を介して、各帯域の近接燃料噴射口３０への燃料供給量Ｑ１と遠隔燃料噴射口４０への燃料供給量Ｑ２との関係は以下のように設定されている。すなわち、加熱帯１Ｐは近接燃料噴射口３０への燃料供給量Ｑ１が、遠隔燃料噴射口４０への燃料供給量Ｑ２に略等しく設定され、加熱帯２Ｈは近接燃料噴射口３０への燃料供給量Ｑ１が、遠隔燃料噴射口４０への燃料供給量Ｑ２よりも大きくなるように設定され、加熱帯３Ｕは近接燃料噴射口３０への燃料供給量Ｑ１が、遠隔燃料噴射口４０への燃料供給量Ｑ２よりも小さくなるように設定されている。なお、第１，第２調節弁３５，４５の開度設定（０～１００）は自動でも手動でもよく、コントローラーにより例えば燃焼条件に応じて制御するようにしてもよい。

【００２０】具体的に説明すると、先ず加熱帯１Ｐの入口側においては、近接燃料噴射口３０への燃料供給量Ｑ１が、遠隔燃料噴射口４０へのそれＱ２に等しく（例えばＱ１：Ｑ２＝５０：５０）なるよう設定されているため、鋼片９０に近い近接燃料噴射口３０の側の火炎の温度が高く、鋼片９０との温度差も大きい。このため、鋼片９０への熱伝達量が高く、鋼片９０の温度は急激に上昇する。なお、この域では鋼片９０の温度が比較的に低いため酸化スケールの生成は少ない。また、火炎の長さは後述する加熱帯２Ｈ，加熱帯３Ｕと比較して短い。

【００２１】さらに、鋼片９０の温度がかなり上昇した、加熱帯２Ｈに近い側では、近接燃料噴射口３０への燃料供給量Ｑ１が、遠隔燃料噴射口４０へのそれＱ２よりも大きく（例えばＱ１：Ｑ２＝１００：０）なるよう設定されているため、近接燃料噴射口３０の側の空気量が不足し、燃焼速度が低下し、火炎が長くなり、その温度が低下するとともに、燃料は不完全燃焼となり、未燃

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焼成分が発生する。この火炎は温度は低いが、その輻射度が高く、鋼片９０に近いため、熱伝達量は比較的高く、短時間に所望の温度に達する。しかし、火炎温度が低いため、その到達温度は低く、過熱されて、溶融等を起すことはない。しかも、雰囲気は還元性となるため、酸化スケールの生成も抑制される。しかしながら、空気噴出口２０より供給される空気量は、バーナ１０全体としては空気比が１より僅かに大きくなるよう供給されているため、近接燃料噴射口３０の側には、部分的に未燃焼成分が一旦発生するが、火炎の先端に向かって空気との混合が進み、最終的には完全に燃焼する。従って、燃焼排ガス量も少なく、熱効率が高く、環境を汚染することもない。なお、燃焼安定化のため、空気噴出口２０に少量の１次燃料を供給してもよい。図３ではＱ１：Ｑ２＝１００：０として運転したが、８０：２０，７０：３０など任意に設定することができる。また、加熱帯１Ｐから加熱帯２Ｈになるに従ってＱ１とＱ２との比率をＱ１：Ｑ２＝５０：５０から６０：４０，７０：３０，８０：２０，９０：１０，１００：１００と徐々にあげていってもよい。

【００２２】次に加熱帯２Ｈにおいては、近接燃料噴射口３０への燃料供給量Ｑ１が、遠隔燃料噴射口４０へのそれＱ２よりも大きい（例えばＱ１：Ｑ２＝１００：０）ため、鋼片９０に近い近接燃料噴射口３０の側の火炎の温度・輻射度が高く、鋼片９０との温度差も大きいため、鋼片９０への熱伝達量が高く、鋼片９０の温度は上昇する。しかも、鋼片９０に近い近接燃料噴射口３０の側の空気量が不足し、未燃焼成分が発生し、還元性雰囲気となるため、鋼片９０の表面の酸化スケールの生成は抑制される。また、火炎は長くなる。

【００２３】最後に加熱帯３Ｕにおいては、近接燃料噴射口３０への燃料供給量Ｑ１が、遠隔燃料噴射口４０へのそれＱ２よりも小さい（例えばＱ１：Ｑ２＝０：１００）ため、鋼片９０に近い近接燃料噴射口３０の側の火炎の温度が低く、鋼片９０との温度差も小さいため、鋼片９０への熱伝達量が低く、鋼片９０の表面温度は殆ど上がらないが、内外の温度の均一化が進む。また、加熱帯２Ｈと同様に長くなる。しかも、近接燃料噴射口３０の側の空気量が過剰となり、鋼片９０の周囲は酸化性雰囲気となり、加熱帯１Ｐ、加熱帯２Ｈで鋼片９０表面に生成した薄く、剥離し難い酸化スケールが酸化され、その剥離性が高められる。他方、遠隔燃料噴射口４０の側に形成される火炎は、鋼片９０からは遠く、天井に近く、その熱は天井で炉内全体に反射されるため、鋼片９０への熱伝達むらが少なくなり、鋼片９０の均熱化を助長する。

【００２４】なお、前述のように、いずれの帯域も、空気噴出口２０より供給される空気量が、バーナ１０全体としては空気比が１より僅かに大きくなるよう設定されることにより、燃料供給量が大きい域は、部分的に未燃

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焼成分が一旦発生するが、火炎の先端に向かって空気との混合が進み、最終的には完全燃焼する。そのため、燃焼排ガス量も少なく、熱効率が高く、環境を汚染することもない。

【００２５】次に第２の実施の形態例について図５乃至図８により説明すると、上述の第２の実施の形態例の構成に加えて、図５に示すように、加熱帯１Ｐにおけるバーナ１０の中心と鋼片９０との距離Ｌ１、加熱帯２Ｈにおけるバーナ１０の中心と鋼片９０との距離Ｌ２及び加熱帯３Ｕにおけるバーナ１０の中心と鋼片９０との距離Ｌ３の関係が、Ｌ１＜Ｌ２＜Ｌ３となるよう各帯域におけるバーナ１０の位置（高さ）が設定されている。それによって、上述の作用効果に加えて、加熱帯１Ｐの近接燃料噴射口３０の側に形成される火炎と鋼片９０との距離が小さいため、加熱帯１Ｐにおける鋼片９０への熱伝達量が大きくなるとともに、温度上昇速度が大きくなり、予熱または加熱に要する時間が短縮される。また、反対に加熱帯３Ｕの遠隔燃料噴射口４０の側に形成される火炎が、鋼片９０からは遠くなり、天井に近くなり、その熱が天井で炉内全体に反射されるため、鋼片９０への熱伝達むらが少なくなり、鋼片９０の温度の均一化が促進される。

【００２６】次に第３の実施の形態例を図９により説明すると、上記連続加熱炉８０の鋼片９０の移動方向に平行な相対する炉壁８１，８１に、それぞれ互いに相対し、対をなすようバーナ１０，１０が配置されている。しかも、相対するバーナ１０，１０の稼動、休止が、所定の時間間隔をおいて交互に繰り返されるよう、すなわち交番に一方のバーナ１０が稼動するよう燃焼加熱条件が以下のように設定されている。すなわち、相対するバーナ１０，１０のいずれか一方が一定時間稼動し、一方の炉壁８１から他方の炉壁８１に向って、空気、燃料が噴射され、その間他方が休止する。次いで反対に、稼動していた一方のバーナ１０が同じ時間休止し、その間他方が稼動し、他方の炉壁８１から一方の炉壁８１に向って、空気、燃料が噴射される。なお、各バーナ１０の全体の空気比は１より僅かに高い値に保持される。

【００２７】各バーナ１０によって形成される火炎は、その燃焼条件の設定によってそれぞれ異なるが、いずれも空気、燃料が噴射される側の炉壁８１から、相対する炉壁８１に向って、温度・形状、雰囲気等が変化し、特有の分布を有する。そのため、鋼片９０に対する幅方向の加熱が均一でなく、加熱むらが生じるおそれがある。それに対して、相対するバーナ１０，１０の稼動、休止が、所定の時間間隔をおいて交互に繰り返されるよう設定されることにより、温度・形状、雰囲気等の分布が所定の時間間隔をおいて逆向きとなり、鋼片９０の幅方向の不均一加熱が平準化されるため、鋼片９０の加熱むらが解消される。なお、バーナ１０，１０を被加熱体９０を挟んで相対する平行な炉壁８１，８１にそれぞれ対を

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なすよう配置するものだけでなく、平行な炉壁８１，８１のうちいずれか一方の炉壁８１（両方でもよい）に隣接して配置するようにしてもよい。

【００２８】最後に第４の実施の形態例を図１０により説明する。上述した第１乃至第３の実施の形態例では、近接燃料噴射口３０への燃料供給量を必要に応じて調節可能な第１調節弁３５と、それとは別に遠隔燃料噴射口４０への燃料供給量を必要に応じて調節可能な第２調節弁４５をそれぞれ付設したものであるが、これにかえて、図１０に示すように、燃料供給量比率調節弁５５を使用して、第１調節弁３５と第２調節弁４５の働きを１つの弁で行えるようにし、近接燃料噴射口３０および遠隔燃料噴射口４０への燃料供給量の比率を必要に応じて調節可能にしてもよい。それによって、被加熱体９０に対して実質的に影響を与える、被加熱体９０に近い側を酸化性または還元性（この中間性のものも含む）の任意の雰囲気に調節可能である。なお、燃料供給量比率調節弁５５の開度設定（０～１００）は自動でも手動でもよく、コントローラーにより例えば燃焼条件に応じて制御するようにしてもよい。

【００２９】なお本実施形態例の連続加熱炉８０は、１つの炉体内が複数の帯域に区画された、一例として３帯域、すなわち鋼片９０の搬入口の帯域にあたる加熱帯１Ｐ，鋼片９０の搬入口の帯域と搬出口の帯域に挟まれた帯域にあたる加熱帯２Ｈ，鋼片９０の搬出口の帯域にあたる加熱帯３Ｕ，の場合を想定して説明したが、特にこれに限られることなく２帯域でも、あるいは４帯域以上のものでも適用されるものである。

【００３０】

【発明の効果】以上のとおり請求項１又は２に記載の発明によれば、鋼片の加熱目的に応じて、帯域毎に近接燃料噴射口への燃料供給量の、遠隔燃料噴射口へのそれに対する比率が適正に設定されているため、鋼片の加熱目的に応じた熱伝達量が得られるとともに、鋼片に対して実質的に影響を与える、鋼片に近い側の雰囲気が適正に保持される。しかもいずれの帯域も、空気噴出口より供給される空気量が、バーナ全体としては空気比が１より僅かに大きくなるよう設定されることにより、燃料供給量が大きい域は、部分的に未燃焼成分が一旦発生するが、火炎の先端に向かって空気との混合が進み、最終的には完全燃焼する。そのため、燃焼排ガス量も少なく、熱効率が高く、環境を汚染することもない。近接燃料噴射口への燃料供給量の、遠隔燃料噴射口へのそれに対する比率を変化させることによって火炎の長さも変更可能である。特に請求項２に記載の発明によれば、２つの調節弁が１つの燃料供給量比率調節弁にかえられるので部品点数が軽減される。

【００３１】請求項３に記載の発明によれば、請求項１又は２に記載の発明の作用効果に加えて、バーナの中心と鋼片との距離が、鋼片の加熱目的に応じて、各帯域毎

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に適正に設定されているため、鋼片の加熱目的に応じた最適の熱伝達量が得られるとともに、鋼片に対して実質的に影響を与える、鋼片に近い側の雰囲気が最適に保持される。

【００３２】請求項４に記載の発明によれば、請求項１，２又は３に記載の発明の作用効果に加えて、空気比が１より僅かに高い値に保持されるので熱効率が高い。そのうえ、いわゆる交番でバーナが稼動されるので、鋼片の幅方向の不均一加熱が平準化され、鋼片の加熱むらが解消される。

【図面の簡単な説明】

【図１】本発明の第１の実施の形態例に係わる連続加熱炉を示す縦断面図である。

【図２】図１の加熱帯１Ｐの一部分を示す横断面図である。

【図３】図１の加熱帯２Ｈの一部分を示す横断面図である。

【図４】図１の加熱帯３Ｕの一部分を示す横断面図である。

【図５】本発明の第２の実施の形態例に係わる連続加熱炉を示す縦断面図である。

【図６】図５の加熱帯１Ｐの一部分を示す横断面図である。

【図７】図５の加熱帯２Ｈの一部分を示す横断面図である。

【図８】図５の加熱帯３Ｕの一部分を示す横断面図である。

【図９】本発明の第３の実施の形態例に係わる連続加熱炉の一部分を示す横断面図である。

【図１０】本発明の第４の実施の形態例に係わる連続加熱炉の一部分を示す横断面図である。

【図１１】従来例を示す縦断面図である。

【図１２】図１１の一部分を示す横断面図である。

【符号の説明】

１	連続加熱炉
１ａ	炉壁
２	バーナ
２ａ	空気噴出口
２ｂ	燃料噴射口
２ｃ	空気
２ｄ	１次燃料
２ｅ	２次燃料
１０	バーナ
２０	空気噴出口
３０	近接燃料噴射口
３５	第１調節弁
４０	遠隔燃料噴射口
４５	第２調節弁
５５	燃料供給量比率調節弁
８０	連続加熱炉

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８１	炉壁
９０	鋼片
Ｌ１	距離
Ｌ２	距離
Ｌ３	距離

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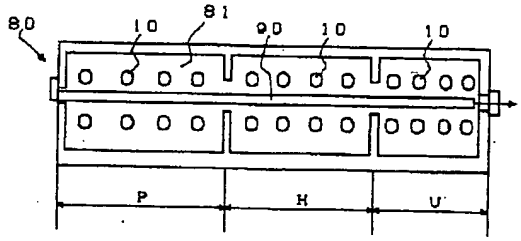
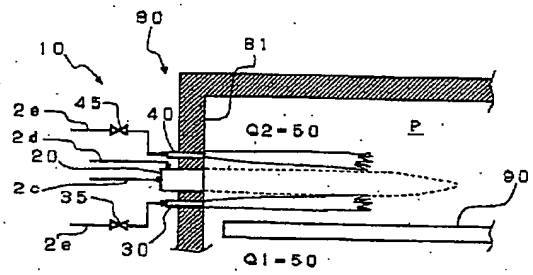
Ｑ１	燃料供給量
Ｑ２	燃料供給量
Ｐ	加熱帯１
Ｈ	加熱帯２
Ｕ	加熱帯３

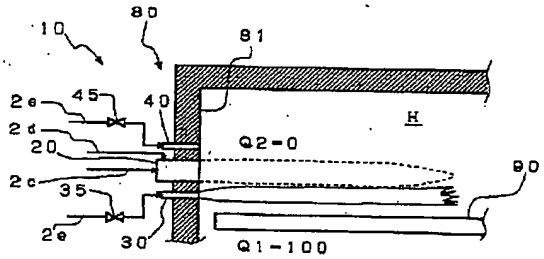
【図１】



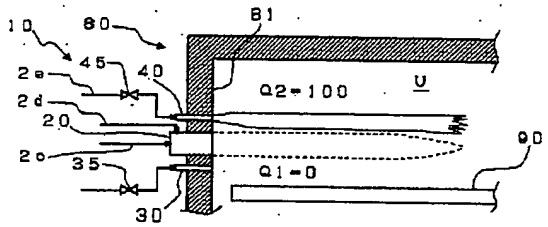
【図２】



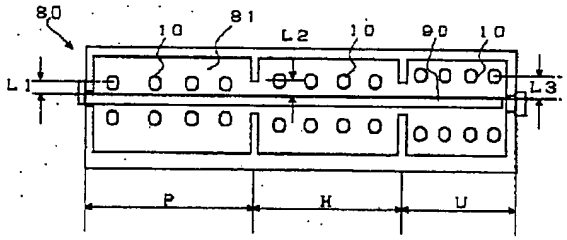
【図３】



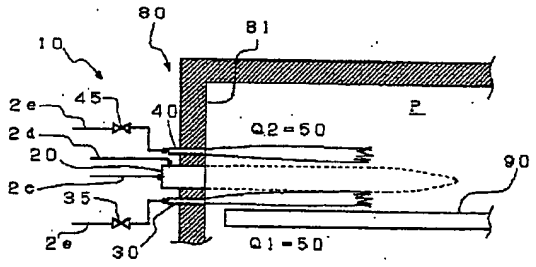
【図４】



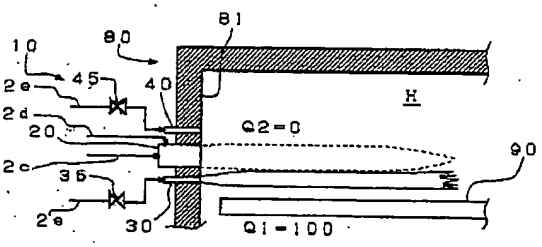
【図５】



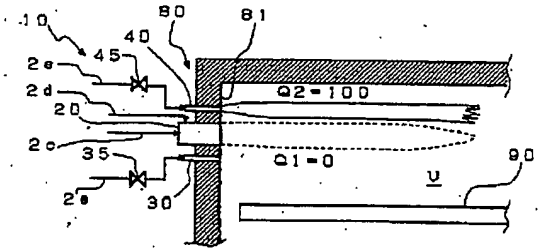
【図６】



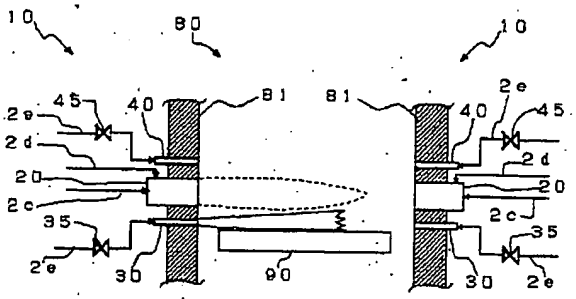
【図７】



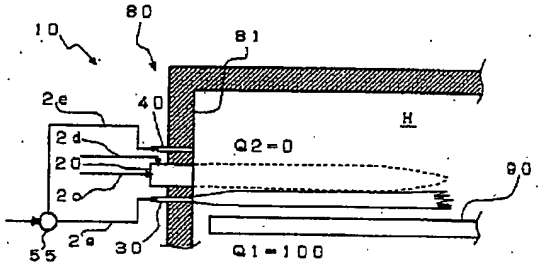
【図8】



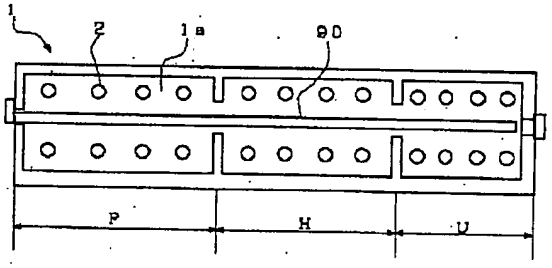
【図9】



【図10】



【図11】



【図12】